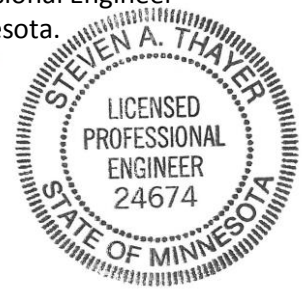
Preliminary Geotechnical Evaluation

Willmar Industrial Park – 4th Addition
30th Street Southwest and Trott Avenue Southwest
Willmar, Minnesota

Prepared for the

Kandiyohi County and City of Willmar EDC

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



Steven A. Thayer, PE
Associate Principal/Senior Engineer
License Number: 24674
June 8, 2016

Project B1603811

Braun Intertec Corporation

Braun Intertec Corporation
3900 Roosevelt Road, Suite 113
Saint Cloud, MN 56301

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June 8, 2016 Project B1603811

Mr. Aaron Backman
Kandiyohi County and City of Willmar EDC
222 20th Street SE
PO Box 1783
Willmar, MN 56201

Re: Preliminary Geotechnical Evaluation
Willmar Industrial Park – 4th Addition
30th Street SW and Trott Avenue SW
Willmar, Minnesota

Dear Mr. Backman:

We are pleased to present this Geotechnical Evaluation Report for the Willmar Industrial Park – 4th Addition. A summary of our results, and a summary of our preliminary recommendations in light of the geotechnical issues influencing design and construction, is presented below. More detailed information and recommendations follow the Table of Contents.

Summary of Results

We completed twelve (12) penetration test borings on the site. The borings generally encountered 1/2 to 1 1/2 feet of topsoil underlain with lean clay fill to depths ranging from 2 1/2 to 9 feet. Boring ST-07 encountered brown to black organic clay (OH) swamp deposit to a depth of 17 1/2 feet. Beneath the fill and organic soils, the borings generally encountered glacial till lean clays (CL) and lean clays with sand to the termination depths of the borings. Boring ST-02 encountered silty sand glacial till from 9 1/2 to 12.

Groundwater was observed only in Boring ST-07, at a depth of 15 feet. However, with clay soils, it can take several hours or days for groundwater to seep into an open borehole. We anticipate groundwater is present in other areas of the site.

Summary of Preliminary Recommendations

The borings encountered topsoil, existing fill, soft clays, and buried organic soils. Depending on the type, size and location of the proposed structures, these materials may be unsuitable for support. A detailed discussion regarding these materials is presented tin the attached report.

Additional Evaluation

As plans for the site develop, we recommend additional penetration test borings or cone penetrometer tests be performed at specific locations within the proposed building and pavement areas, and that a geotechnical engineer evaluate the results.

General

Please refer to the attached report for a more detailed summary of our preliminary analyses and recommendations. For additional explorations, or if you have any questions, please contact Steve Thayer at 320.202.7225.

Sincerely,

BRAUN INTERTEC CORPORATION

David Morrison, EIT
Staff Engineer

Steve A. Thayer, PE
Associate Principal/Senior Engineer

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Description **Page**

Appendix

BRAUN INTERTEC

A. Introduction

A.1. Project Description

The Kandiyohi County and City of Willmar Economic Development Commission (EDC) are planning a 4th addition to the Willmar Industrial Park.

The site of the addition currently exists as a 90-acre agricultural field located west of 30th Street southwest and about 1/2 mile south of Highway 12 in Willmar, Minnesota. The development will likely include the construction of new buildings with associated parking lots, drives and utilities.

A.2. Purpose of this Preliminary Geotechnical Evaluation

The purpose of this preliminary geotechnical evaluation was to characterize subsurface geologic conditions at selected exploration locations and provide a summary of their potential impact on the design and construction of buildings and pavements on the site.

A.3. Background Information and Reference Documents

To facilitate our evaluation, we were provided with or reviewed the following information or documents:

- A Geologic Map of Minnesota, by Howard C. Hobbs and Joseph E. Goebel, 1982.
- Aerial Maps. We reviewed aerial photographs of the project area using Google Earth®.
- Willmar Industrial Park – Survey Areas
- Willmar Industrial Park – Utility Map, prepared by Bolton & Menk, Inc., dated March 2016

Copies of the Willmar Industrial Park – Survey Areas and Willmar Industrial Park – Utility Map have been included in the Appendix of this report.

A.4. Site Conditions

The site was previously utilized as the Willmar Municipal Airport, which has since moved to a new site. The airport consisted of a bituminous paved runway, orientated in the northwest to southeast direction and multiple airplane hangars. The majority of the hangers and east portion of the runway have been demolished to allow for previous industrial park expansions and the construction of 30th Street southwest. Currently, utilities and roadways associated with the industrial park addition have been constructed.

A.5. Scope

Our scope of services for this project was originally submitted as a proposal to Aaron Backman of Kandiyohi County and City of Willmar Economic Development Commission (EDC). Four additional borings were added to the scope on April 29. 2016. We received authorization to proceed from Mr. Backman on May 3, 2016. Tasks completed in accordance with our authorized scope of services are described below.

Our scope of services was performed under the terms of our September 1, 2013, General Conditions.

- Coordinating the locating of underground utilities near the boring locations.
- Conducting twelve (12) standard penetration test borings to a nominal depth of 20 feet below the existing ground surface.
- Recording the depths at which groundwater was observed.
- Returning the samples to our laboratory for visual classification and logging by a geotechnical engineer.
- Submitting this preliminary geotechnical evaluation report containing the logs of the borings, a sketch showing the boring locations, preliminary grading recommendations for structural support and a range of allowable bearing pressure for design of spread footings.

A.6. Locations and Elevations

The desired boring locations were provided to us by the Kandiyohi County and City of Willmar EDC.

We staked and surveyed the boring locations using GPS (Global Positioning System) technology that utilizes the Minnesota Department of Transportation's (MnDOT's) permanent GPS Virtual Reference Network (VRN).

B. Results

B.1. Exploration Logs

B.1.a. Log of Boring Sheets

Log of Boring sheets for our penetration test borings are included in the Appendix. The logs identify and describe the geologic materials that were penetrated, and present the results of penetration resistance

tests performed within them, laboratory tests performed on penetration test samples retrieved from them, and groundwater measurements.

Strata boundaries were inferred from changes in the penetration test samples and the auger cuttings. Because sampling was not performed continuously, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may also occur as gradual rather than abrupt transitions.

B.1.b. Geologic Origins

Geologic origins assigned to the materials shown on the logs and referenced within this report were based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

B.2. Geologic Materials

The general geologic profile at the site (proceeding downward from the existing ground surface) consists of 1/2 to 1 1/2 feet of topsoil underlain with clay fill to depths ranging from 2 1/2 to 9 feet. Boring ST-07 encountered brown to black organic clay (OH) swamp deposit to a depth of 17 1/2 feet. Beneath the fill and organic soils, the borings generally encountered glacial till lean clays (CL) and lean clays with sand to the termination depths of the borings. Boring ST-02 encountered silty sand glacial till from 9 1/2 to 12.

B.3. Groundwater

Groundwater was observed at a depth of approximately 15 feet in boring ST-07. This depth corresponds to an elevation of approximately 1108 feet. The water appeared to be associated with the organic soils encountered in this boring. Given the cohesive nature of the geologic materials encountered, however, it is likely that insufficient time was available for groundwater to seep into the other boreholes and rise to its hydrostatic level. Piezometers or monitoring wells would be required to confirm if groundwater was present within the depths explored.

Seasonal and annual fluctuations of groundwater should also be anticipated.

B.4. Laboratory Test Results

The moisture content of the sands was determined to be approximately 18 percent, indicating that the material was at its probable optimum moisture content. Our mechanical analyses indicated that the sands contained 22 1/2 percent silt and clay by weight.

The moisture content of the clay was determined to vary from approximately 16 1/2 to 22 percent, indicating that the material was at or above of its probable optimum moisture content. The moisture content of the organic clay was determined to vary from approximately 35 to 55 percent, indicating it was wet.

Individual test results are provided on the Log of Boring sheets, adjacent the samples tested.

C. Preliminary Analysis and Recommendations

C.1. Proposed Construction

We understand the 90 acre agricultural land, located west of 30th street southwest and south of Highway 12 in Willmar, Minnesota is being developed for the 4th expansion of the Willmar Industrial Park. The building design and locations have not been determined at this time. The development is likely to include light building construction with associated underground utilities, parking areas and driveways.

C.2. Discussion

The borings encountered topsoil, existing fill, soft clays, and buried organic soils (swamp deposits). Depending on the type, size and location of the proposed structures, these materials may be unsuitable for support. Mitigation of these materials may be required.

C.2.a. Topsoil

The borings generally encountered topsoil over clay fill above glacial till lean clays. The topsoil contains organic materials with are compressible and highly frost susceptible and therefore are not suitable for supporting footings, slabs, pavements and sidewalks. Therefore, it should be completely removed from below foundations, slab, pavements and sidewalks.

C.2.b. Existing Fill

Below the topsoil, the borings encountered existing fill (materials placed by man rather than by nature). The fill soils were variable in composition and density. It appears the fills were not placed with the intent of supporting structural loads. We recommend they not be relied upon for support foundations or slabs; however the fills may be suitable for supporting pavements and sidewalks, provided they do not contain organic materials. We recommend the existing fills be removed from proposed buildings and replaced with structural fill. Additional investigation should be conducted to determine if they are suitable for pavements and sidewalks.

C.2.c. Swamp Deposits

Swamp deposits, consisting of black organic clay, were encountered in Boring ST-07. Organic soils hold moisture, are frost susceptible, and are compressible. It is difficult to estimate the quantity and rate of settlement of organic soils. Based on past experience with similar projects, we estimate that settlement could range from several feet to one-half the thickness of the organic layer. If left in place, future structures will settle. We recommend the organic soils be removed from proposed buildings and replaced with structural fill. An alternative to complete removal is to support structures on deep foundations such as driven piles or piers bearing in the soils below.

C.2.d. Soft Clays

The underlying native clays soils appear suitable for light building construction supported on spread footing foundation and floor slabs. It should be noted however, the soft clays (5 BPF or less) at depth may cause excessive settlements if heavy loads are applied. Also, new fill placed over the soft clays may cause the soils to consolidate causing excessive settlement.

The magnitude of settlement due to consolidation of soft clays due to foundation or fill loads is dependent on the amount of load applied. Detail analysis during project specific geotechnical evaluations will be required.

We will note that if heavy structural loads are planned, deep foundations or ground improvement techniques may be required.

C.2.e. Frost Susceptible Materials

The clays soils encountered in the borings are considered highly frost susceptible. Relatively thick pavement sections will be required.

C.3. Additional Exploration

When plans are more definite, we recommend additional penetration test borings or cone penetrometer tests be performed at specific locations within the building, slab and pavement areas to further evaluate the local characteristics of the soils for foundation, slab and pavement support. An experienced geotechnical engineer should evaluate the suitability of the soils in the construction areas.

D. Procedures

D.1. Drilling and Sampling

The penetration test borings were performed with a truck-mounted core and auger drill equipped with 3 1/4-inch inside diameter hollow-stem auger. Sampling for the borings was conducted in general accordance with ASTM D 1586, "Penetration Test and Split-Barrel Sampling of Soils." We advanced the boreholes with hollow-stem auger to the desired test depths. A 140-pound hammer falling 30 inches was then used to drive the standard 2-inch split-barrel sampler a total penetration of 1 1/2 feet below the tip of the hollow-stem auger. The blows for the last foot of penetration were recorded and are in an index of soil strength characteristics. Samples were taken at 2 1/2-foot vertical intervals to the termination depth of 15 feet and at 5-foot vertical intervals below 15 feet. A portion of each sample was placed in a glass jar.

D.2. Soil Classification

Our drill crew visually and manually classified the soils encountered in the borings in accordance with ASTM D 2488, "Description and Identification of Soils (Visual-Manual Procedures)." A summary of the ASTM classification system is included in the Appendix. A geotechnical engineer then returned all samples to our laboratory for review of the field classifications. Samples will remain in our Duluth office for a period of sixty days to be available for examination.

D.3. Groundwater Observations

Observed depths to groundwater were noted while drilling. Immediately after taking the final samples in the bottom of the borings, the holes were probed through the hollow-stem auger to check for the

presence of groundwater. Immediately after withdrawal of the auger, the holes were again probed and the depths to water or cave-in were noted. The borings were then immediately backfilled.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

Our evaluation, analyses and recommendations were developed from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth, and therefore strata boundaries and thicknesses must be inferred to some extent. Strata boundaries may also be gradual transitions, and can be expected to vary in depth, elevation and thickness away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until additional exploration work is completed, or construction commences. If any such variations are revealed, our recommendations should be re-evaluated. Such variations could increase construction costs, and a contingency should be provided to accommodate them.

E.1.b. Groundwater Levels

Groundwater measurements were made under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. It should be noted that the observation periods were relatively short, and groundwater can be expected to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

E.2. Use of Report

This report is for the exclusive use of the parties to which it has been addressed. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.3. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

200' 0 400'

SCALE: 1" = 400'

BRAUN INTERTEC
The Science You Build On.
11001 Hampshire Avenue S
Minneapolis, MN 55438
PH. (952) 995-2000
FAX (952) 995-2020

SOIL BORING LOCATION SKETCH

GEOTECHNICAL EVALUATION
WILLMAR INDUSTRIAL PARK
INTERSECTION OF 30TH STREET SW AND TROTT AVENUE SW
WILLMAR, MINNESOTA

Project No:	B1603811
Drawing No:	B1603811
Scale:	1" = 400'
Drawn By:	BJB
Date Drawn:	4/28/16
Checked By:	DM
Last Modified:	5/10/16
Sheet:	Fig:
of	

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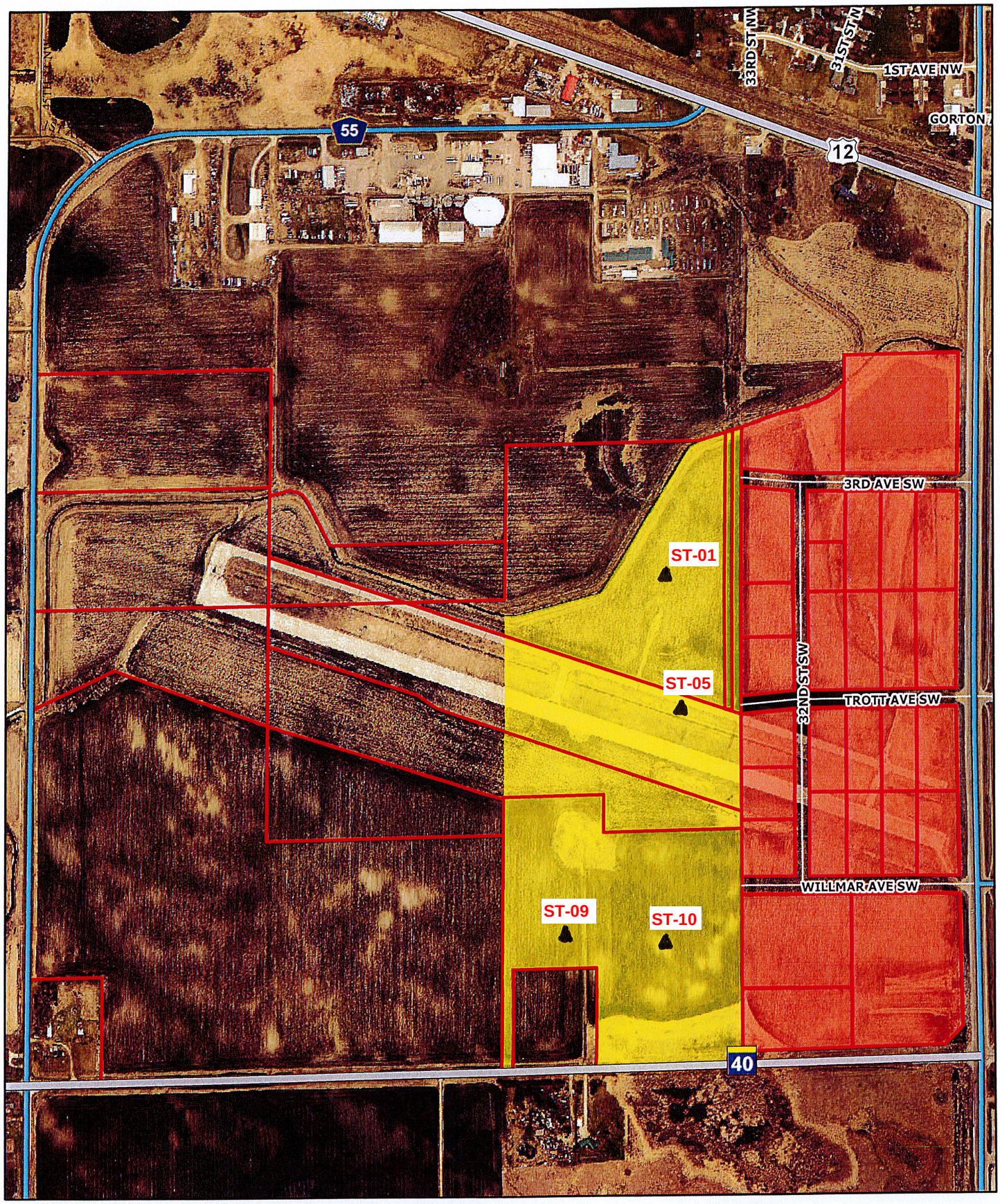
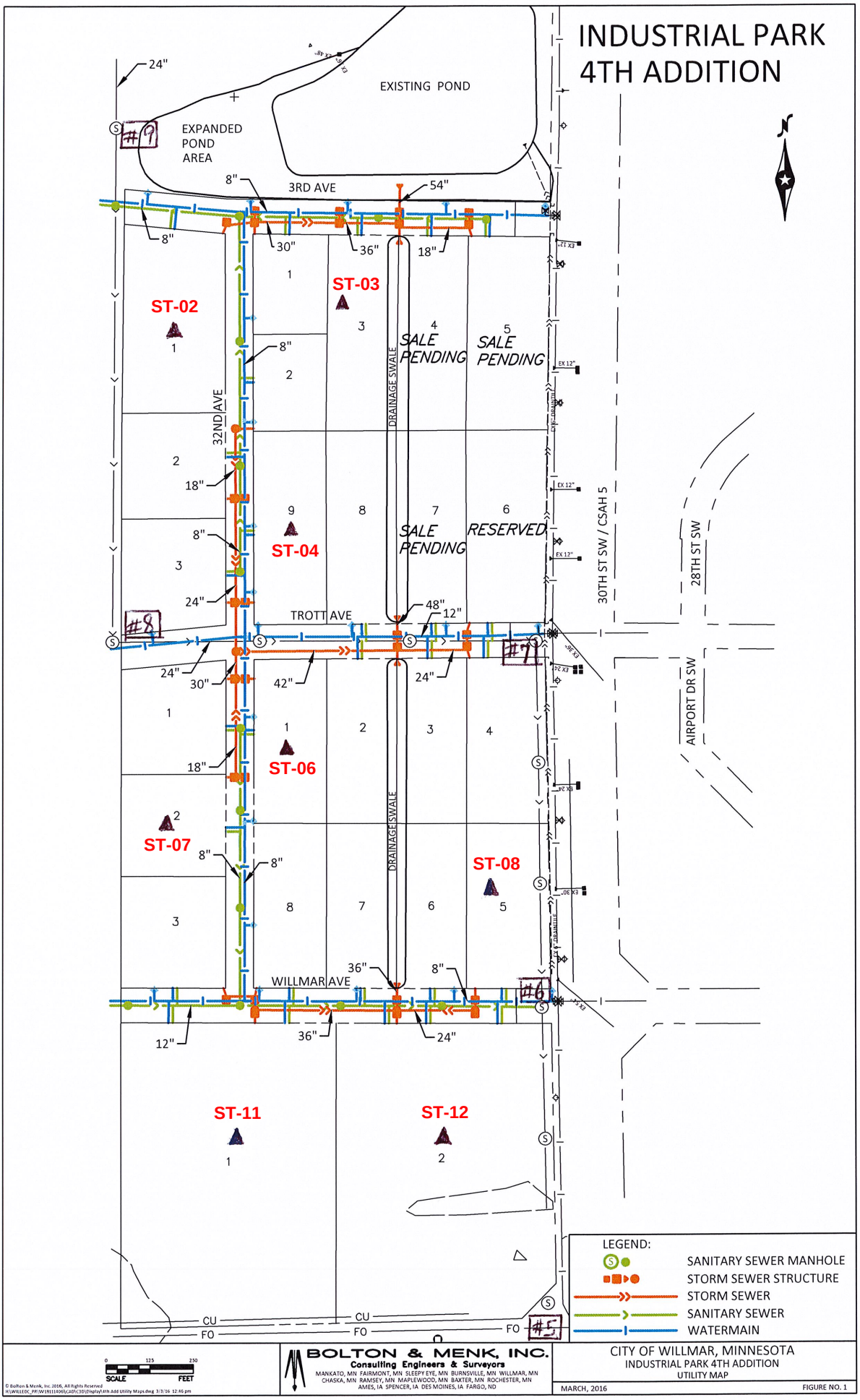


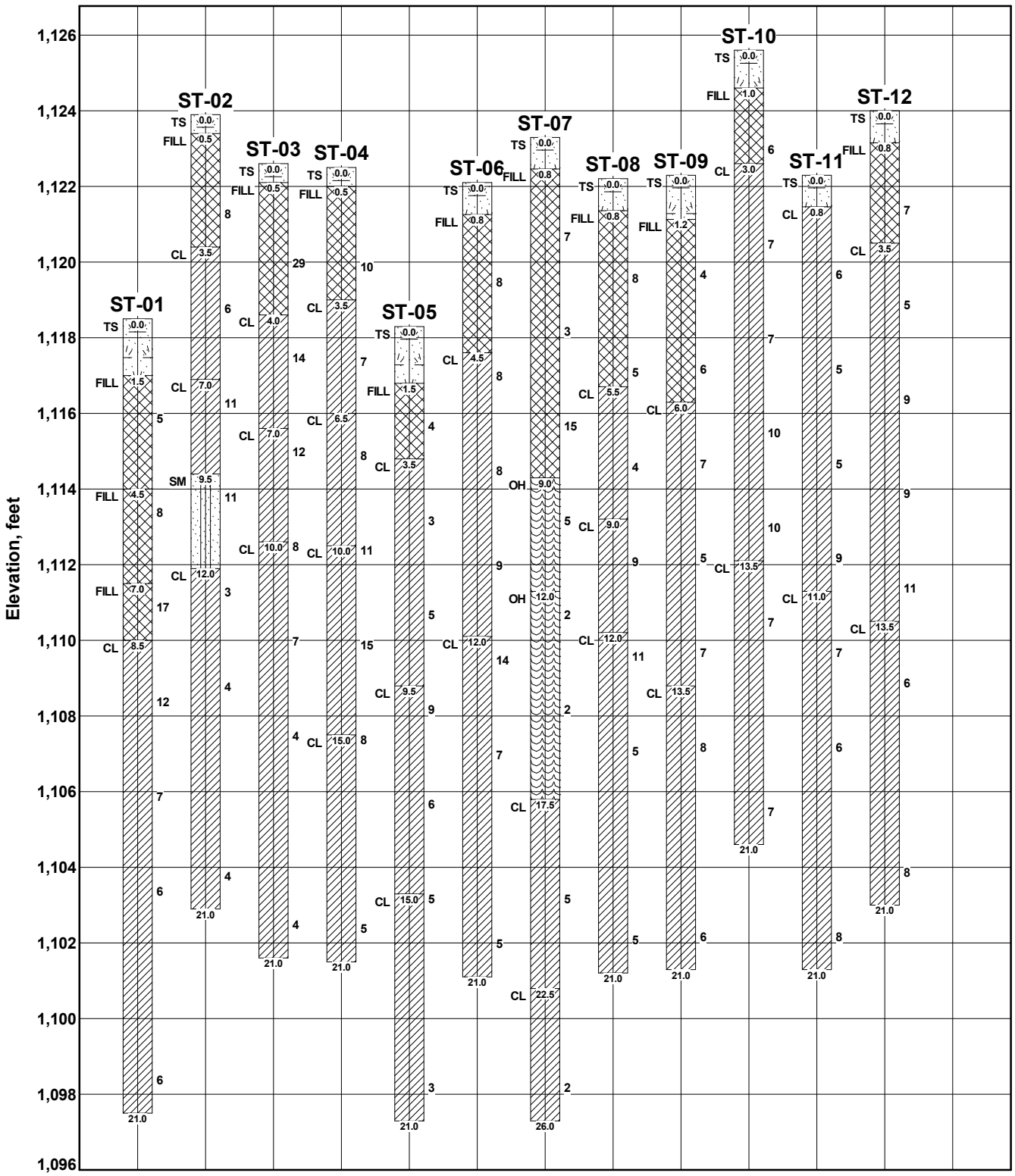
Willmar Industrial Park - Survey Areas

Section 17
Willmar Township

Legend

- City of Willmar Parcels
- Proposed Additional Survey Area
- Industial Park 4th Add Survey Area


INDUSTRIAL PARK
4TH ADDITION
EXISTING POND
EXPANDED
POND
AREA
#9
#8
#7
#6
#5
3RD AVE
TROTT AVE
WILLMAR AVE
32ND AVE
DRAINAGE SWALE
DRAINAGE SWALE
30TH ST SW / CSAH 5
28TH ST SW
AIRPORT DR SW
ST-02
ST-03
ST-04
ST-06
ST-07
ST-08
ST-11
ST-12
SALE PENDING
SALE PENDING
SALE PENDING
RESERVED
24"
8"
30"
36"
18"
54"
48"
12"
42"
CU
FO
LEGEND:
SANITARY SEWER MANHOLE
STORM SEWER STRUCTURE
STORM SEWER
SANITARY SEWER
WATERMAIN
SCALE
FEET
BOLTON & MENK, INC.
Consulting Engineers & Surveyors
MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN
CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN
AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND
CITY OF WILLMAR, MINNESOTA
INDUSTRIAL PARK 4TH ADDITION
UTILITY MAP
MARCH, 2016
FIGURE NO. 1



Fence Diagram: Point to Point

(Horizontal distance not to scale)

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BRAUN INTERTEC

ELEVATION SCALE N:\GINT\PROJECTS\AX PROJECTS\2016\03811.GPJ BRAUN_V8_CURRENT.GDT 6/8/16 09:32

B1603811

BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-01**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/5/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1118.5	0.0					
		TS	17 inches of TOPSOIL.			
1117.0	1.5	FILL	FILL: Lean Clay, with Silt, brownish gray, moist.	5		
1114.0	4.5	FILL	FILL: Sandy Lean Clay, with Silt, brown, moist.	8		
1111.5	7.0	FILL	FILL: Silty Sand, with Clay, light brown, moist.	17		
1110.0	8.5	CL	LEAN CLAY, with Sand, grayish brown, moist, rather stiff to medium. (Glacial Till)	12		
				7		
				6		
1097.5	21.0			6		
			END OF BORING. Water not observed while drilling. Boring then backfilled.			

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LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-02**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/5/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	P200 %	Tests or Notes
1123.9	0.0							
1123.4	0.5	TS	6 inches of TOPSOIL.					
		FILL	FILL: Sandy Lean Clay, brown, moist.	8				
1120.4	3.5	CL	SANDY LEAN CLAY, brownish gray, moist, medium. (Glacial Till)	6				
1116.9	7.0	CL	LEAN CLAY, with Sand, brown, moist, rather stiff. (Glacial Till)	11				
1114.4	9.5	SM	SILTY SAND, with Clay, brown, moist, medium dense. (Glacial Till)	11		18	22.5	
1111.9	12.0	CL	LEAN CLAY, with Sand, brown to grayish brown, moist, soft to rather soft. (Glacial Till)	3				
				4				
1102.9	21.0			4				
			END OF BORING. Water not observed while drilling. Boring then backfilled.					

(See Descriptive Terminology sheet for explanation of abbreviations)

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LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-03**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/5/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1122.6	0.0					
1122.1	0.5	TS	6 inches of TOPSOIL.			
		FILL	FILL: Lean Clay, brown to dark brown, moist.	29		
1118.6	4.0	CL	LEAN CLAY, with Sand, brown, wet, stiff. (Glacial Till)	14		
1115.6	7.0	CL	LEAN CLAY, with Sand, brown, moist, rather stiff. (Glacial Till)	12		
1112.6	10.0	CL	LEAN CLAY, with Sand, grayish brown, moist, rather soft to medium. (Glacial Till)	8		
				7		
				4		
1101.6	21.0			4		
			END OF BORING.			
			Water not observed while drilling.			
			Boring then backfilled.			

BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-04**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/5/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1122.5	0.0					
1122.0	0.5	TS	6 inches of TOPSOIL.			
		FILL	FILL: Lean Clay, with a trace of organics and Sand, black, moist.	10		
1119.0	3.5	CL	LEAN CLAY, with Sand and Silt, and a trace of Gravel, brown, moist, medium. (Glacial Till)	7		
1116.0	6.5	CL	LEAN CLAY, with a trace of Sand and Gravel, brown, moist, medium. (Glacial Till)	8		
1112.5	10.0	CL	LEAN CLAY, with Sand, grayish brown, moist, rather stiff to stiff. (Glacial Till)	11		
				15		
1107.5	15.0	CL	LEAN CLAY, grayish brown, wet, medium to rather stiff. (Glacial Till)	8		
1101.5	21.0		END OF BORING.	5		
			Water not observed while drilling.			
			Boring then backfilled.			

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BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-05**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/4/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1118.3	0.0						
		TS	17 inches of TOPSOIL.				
1116.8	1.5	FILL	FILL: Lean Clay, with a trace of Sand, gray, moist.	4		21.5	
1114.8	3.5	CL	LEAN CLAY, with Sand, brown, gray, wet, soft to rather soft. (Glacial Till)	3		20.5	
				5		18.5	
1108.8	9.5	CL	LEAN CLAY, with Sand, grayish brown, moist, medium to rather stiff. (Glacial Till)	9		17	
				6		16.5	
1103.3	15.0	CL	LEAN CLAY, with a trace of Gravel, grayish brown, wet, soft to rather soft. (Glacial Till)	5		17	
1097.3	21.0			3		18	
			END OF BORING.				
			Water not observed while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2016\03811.GPJ BRAUN_V8_CURRENT.GDT 6/8/16 09:02

BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-06**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/5/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1122.1	0.0					
1121.3	0.8	TS	10 inches of TOPSOIL.			
		FILL	FILL: Lean Clay, with Sand and a trace of roots and fibers, dark brown, moist.	8		
1117.6	4.5	CL	LEAN CLAY, with Sand and a trace of Gravel, brown, moist, medium to rather stiff. (Glacial Till)	8		
				8		
				9		
1110.1	12.0	CL	LEAN CLAY, with Sand and a trace of Gravel, brown to grayish brown, moist, stiff to rather soft. (Glacial Till)	14		
				7		
1101.1	21.0			5		
			END OF BORING. Water not observed while drilling. Boring then backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2016\03811.GPJ BRAUN_V8_CURRENT.GDT 6/8/16 09:02

BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-07**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/4/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	Tests or Notes
1123.3	0.0						
1122.5	0.8	TS	10 inches of TOPSOIL.				
		FILL	FILL: Lean Clay, with a trace of Sand and Gravel, dark brown to grayish brown, moist.	7			
				3			
				15		20	
1114.3	9.0						
		OH	ORGANIC CLAY, black, moist, rather soft. (Swamp Deposit)	5		54.5	
1111.3	12.0						
		OH	ORGANIC CLAY, brown, wet, soft. (Swamp Deposit)	2		35.5	
				2		44	
1105.8	17.5						
		CL	LEAN CLAY, with Silt, gray, wet, rather soft. (Glacial Till)	5		19	
1100.8	22.5						
		CL	LEAN CLAY, with Sand, brown, wet, soft. (Glacial Till)	2		20	
1097.3	26.0						
			END OF BORING.				
			Water observed at 15 feet while drilling.				
			Boring then backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-08**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/5/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1122.2	0.0					
1121.4	0.8	TS	10 inches of TOPSOIL.			
		FILL	FILL: Lean Clay, with a trace of Sand and roots and fibers, brown, moist.	8		
1116.7	5.5	CL	LEAN CLAY, with a trace of Sand, brownish tan, wet, rather soft. (Glacial Till)	5		
1113.2	9.0	CL	LEAN CLAY, with a trace of Sand, brown, moist, rather stiff. (Glacial Till)	4		
1110.2	12.0	CL	LEAN CLAY, with Sand, brown to brownish gray, moist, rather stiff to rather soft. (Glacial Till)	9		
				11		
				5		
1101.2	21.0			5		
			END OF BORING. Water not observed while drilling. Boring then backfilled.			

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BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-09**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/4/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1122.3	0.0					
		TS	14 inches of TOPSOIL.			
1121.1	1.2					
		FILL	FILL: Lean Clay, with a trace of Sand, brown with black mottling, wet.	4		
				6		
1116.3	6.0					
		CL	LEAN CLAY, with a trace of Sand, brown, wet, rather soft to medium. (Glacial Till)	7		
				5		
1108.8	13.5			7		
		CL	LEAN CLAY, with Sand, gray, wet to moist, medium. (Glacial Till)	8		
1101.3	21.0			6		
			END OF BORING.			
			Water not observed while drilling.			
			Boring then backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-10**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/4/16** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1125.6	0.0					
1124.6	1.0	TS	12 inches of TOPSOIL.			
		FILL	FILL: Lean Clay, with Sand, brownish tan, moist.			
1122.6	3.0			6		
		CL	LEAN CLAY, with Sand, brown with gray mottling, moist, medium to rather stiff. (Glacial Till)	7		
				7		
				10		
1112.1	13.5			10		
		CL	LEAN CLAY, with Sand and a trace of Gravel, gray, wet, medium. (Glacial Till)	7		
1104.6	21.0			7		
			END OF BORING. Water not observed while drilling. Boring then backfilled.			

BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-11**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/4/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1122.3	0.0					
1121.5	0.8	TS	10 inches of TOPSOIL.			
		CL	LEAN CLAY, with a trace of Sand and Gravel, brown, moist, rather soft to rather stiff. (Glacial Till)	6		
				5		
				5		
1111.3	11.0			9		
		CL	LEAN CLAY, with a trace of Sand and Gravel, gray, wet, medium. (Glacial Till)	7		
				6		
1101.3	21.0			8		
			END OF BORING. Water not observed while drilling. Boring then backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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BRAUN INTERTEC

LOG OF BORING

Braun Project B1603811
Geotechnical Evaluation
Willmar Industrial Park - 4th Addition
Intersection of 30th Street SW and Trott Avenue SW
Willmar, Minnesota

BORING: **ST-12**

LOCATION: See attached sketch.

DRILLER: R. Hansen | METHOD: 3 1/4" HSA, Autohammer | DATE: **5/4/16** | SCALE: **1" = 4'**

Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
1124.0	0.0					
1123.2	0.8	TS	10 inches of TOPSOIL.			
		FILL	FILL: Lean Clay, with a trace of Sand, brown to dark brown.	7		
1120.5	3.5	CL	LEAN CLAY, with a trace of Sand, brown, rather soft to rather stiff. (Glacial Till)	5		
				9		
				9		
1110.5	13.5			11		
		CL	LEAN CLAY, with a trace of Sand and Gravel, gray, wet, medium. (Glacial Till)	6		
1103.0	21.0			8		
			END OF BORING. Water not observed while drilling. Boring then backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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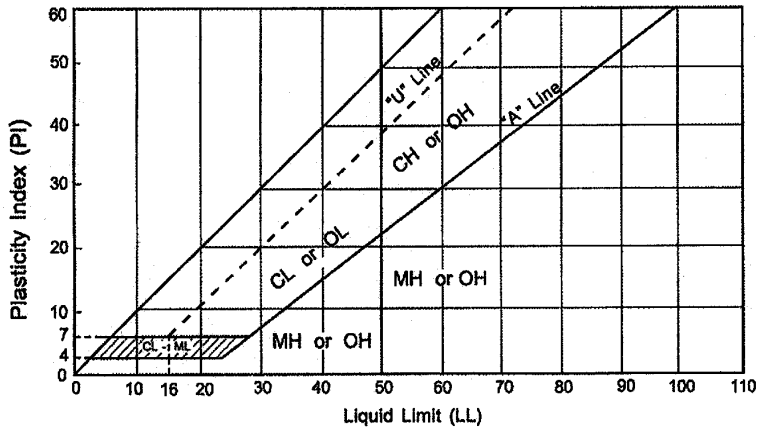
BRAUN INTERTEC

Descriptive Terminology of Soil

Standard D 2487
Classification of Soils for Engineering Purposes
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soils Classification	
				Group Symbol	Group Name [b]
Coarse-grained Soils more than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines [e]	$C_u \geq 4$ and $1 \leq C_c \leq 3$ [c]	GW	Well-graded gravel [d]
			$C_u < 4$ and/or $1 > C_c > 3$ [c]	GP	Poorly graded gravel [d]
		Gravels with Fines More than 12% fines [e]	Fines classify as ML or MH	GM	Silty gravel [d f g]
			Fines classify as CL or CH	GC	Clayey gravel [d f g]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines [i]	$C_u \geq 6$ and $1 \leq C_c \leq 3$ [c]	SW	Well-graded sand [h]
			$C_u < 6$ and/or $1 > C_c > 3$ [c]	SP	Poorly graded sand [h]
		Sands with Fines More than 12% [i]	Fines classify as ML or MH	SM	Silty sand [f g h]
			Fines classify as CL or CH	SC	Clayey sand [f g h]
Fine-grained Soils 50% or more passed the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [j]	CL	Lean clay [k l m]
			PI < 4 or plots below "A" line [j]	ML	Silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [k l m n]
				OL	Organic silt [k l m o]
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [k l m]
			PI plots below "A" line	MH	Elastic silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [k l m p]
				OH	Organic silt [k l m q]
Highly Organic Soils	Primarily organic matter, dark in color and organic odor			PT	Peat

a. Based on the material passing the 3-inch (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60}/D_{10}$ $C_c = \frac{(D30)^2}{D_{10} \times D_{60}}$
d. If soil contains ≥15% sand, add "with sand" to group name.
e. Gravels with 5 to 12% fines require dual symbols:
   GW-GM well-graded gravel with silt
   GW-GC well-graded gravel with clay
   GP-GM poorly graded gravel with silt
   GP-GC poorly graded gravel with clay
f. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g. If fines are organic, add "with organic fines: to group name.
h. If soil contains ≥15% gravel, add "with gravel" to group name.
i. Sand with 5 to 12% fines require dual symbols:
   SW-SM well-graded sand with silt
   SW-SC well-graded sand with clay
   SP-SM poorly graded sand with silt
   SP-SC poorly graded sand with clay
j. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
m. If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
n. PI ≥ 4 and plots on or above "A" line.
o. PI < 4 or plots below "A" line.
p. PI plots on or above "A" lines.
q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	**OC**	Organic content, %
WD	Wet density, pcg	**S**	Percent of saturation, %
MC	Natural moisture content, %	**SG**	Specific gravity
LL	Liquid limit, %	**C**	Cohesion, psf
PL	Plastic limits, %	**Ø**	Angle of internal friction
PI	Plasticity index, %	**qu**	Unconfined compressive strength, psf
P200	% passing 200 sieve	**qp**	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders..... over 12"
Cobbles ..... 3" to 12"
Gravel
  Coarse ..... 3/4" to 3"
  Fine..... No. 4 to 3/4"
Sand
  Coarse ..... No. 4 to No. 10
  Medium..... No. 10 to No. 40
  Fine..... No. 40 to No. 200
Silt ..... <No. 200, PI< 4 or below "A" line
Clay ..... <No. 200, PI ≥ 4 and on or about "A" line

Relative Density of Cohesionless Soils

Very Loose..... 0 to 4 BPF
Loose..... 5 to 10 BPF
Medium dense ..... 11 to 30 PPF
Dense ..... 31 to 50 BPF
Very dense..... over 50 BPF

Consistency of Cohesive Soils

Very soft..... 0 to 1 BPF
Soft..... 2 to 3 BPF
Rather soft ..... 4 to 5 BPF
Medium..... 6 to 8 BPF
Rather stiff ..... 9 to 12 BPF
Stiff ..... 13 to 16 BPF
Very stiff..... 17 to 30 BPF
Hard..... over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers, unless noted otherwise. Jetting water was used to clean out auger prior to sampling only where indicated on logs. All samples were taken with the standard 2" OD split-tube samples, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous flight, solid-stern augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface, and are therefore, somewhat approximate.

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn.

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments, and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight, and driving not required.

TW: TW indicates thin-walled (undisturbed) tube sample.

Note: All tests were run in general accordance with applicable ASTM standards.